

DOCUMENT RESUME

ED 389 134

EC 304 420

AUTHOR Price, Geraldine
TITLE The Use of Portable Computers with Dyslexic Students. Occasional Papers 26.
INSTITUTION Southampton Univ. (England). Centre for Language Education.
PUB DATE Jul 94
NOTE 29p.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Assistive Devices (for Disabled); Attitude Change; *Computer Uses in Education; *Dyslexia; Educational Media; Elementary Secondary Education; Foreign Countries; *Learning Disabilities; Microcomputers; Participant Satisfaction; *Student Attitudes; Writing Skills
IDENTIFIERS *Laptop Computers; United Kingdom

ABSTRACT

This British study evaluated the effectiveness of use of individual portable computers by seven students (from elementary through college age) having severe specific learning difficulties or dyslexia. The study also examined the impact of the machines on pupils' levels of independence and the practicalities of using the machines. This report describes the project's objectives and management, criteria for selection of students, and student preparation and machine set-up. Use of the computers was analyzed in terms of frequency of use and diversity of use. Emphasized throughout the project was student control of machine use. Frequency of use was sometimes limited by the machines' weight, as well as by individual student personality and group dynamics. Diversity of use was somewhat dependent upon the student age and type of written work expected at different stages in the educational setting. The study found that students improved substantially in their notetaking skills, attitudes toward work, attitudes toward spelling, writing skills, and keyboarding skills. Other changes included increased independence in learning style. Minimal organizational accommodations were required of the schools involved. Factors determining success of such a project are noted, along with implications of the project in terms of the relationship of computers to teaching style, handwriting in the National Curriculum, and requirements for "written" assessment. (Contains 22 references.) (DB)

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UNIVERSITY OF SOUTHAMPTON
OCCASIONAL PAPERS, 26

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THE USE OF PORTABLE COMPUTERS
WITH DYSLEXIC STUDENTS

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The Use of Portable Computers with Dyslexic Students

D f E Portable Computers in Schools Project.

Acknowledgements

My thanks to the schools and 6th Form Colleges who participated in this pilot project. The co-operation of colleagues in Highfield Middle School, Sholing Girls' School, Aster House Unit for Emotionally Disturbed Pupils, Itchen 6th Form College and Southampton Technical College was much appreciated.

I am indebted to Mr. David Brunner in the School of Education without whom many of the technical 'molehills' would have turned into 'mountains'.

Background.

The National Council for Educational Technology (NCET) was commissioned to manage a £2.55m pilot evaluation study for the Department for Education (DfE) to assess the curriculum value of portable computers in primary and secondary schools in England. The National Foundation for Educational Research (NFER) was asked to evaluate the findings of all the projects. There were 118 individual projects in the study. Of the 118 projects, only five have focussed on the needs of students and pupils with Specific Learning Difficulties (Dyslexia).

This project was provided with eight portable computers for use with individual students and pupils. It was decided that the machines would have to be compatible with similar technology in schools and colleges. Thus, four of the machines were IBM PC compatible and four of the machines were Acorn compatible. The hardware consisted of:-

- a Toshiba 1864 A4 portable with hard and floppy disk drives;
- three Compaq Contura 3/20 A4 portables with hard and floppy disk drives;
- four Acorn A4 portables with hard and floppy disk drives.
- a portable inkjet printer.

Each of the PC machines ran Microsoft Works and Publisher under Windows; while the new Advance program was installed onto the Acorn machines.

The cost of the management of the project was supported by an IBM research project for the use of IT with Special Educational Needs pupils.

Objectives of the Project

The original bid for the project detailed five key objectives:-

- *to evaluate the effectiveness of portable computers with students with Specific Learning Difficulties (Dyslexia);*
- *to increase independence of learning for those disadvantages students;*
- *to evaluate the portable computer as a means of supporting writing skills;*
- *to assess the practicalities of using portable computers in schools and colleges for SEN (Dyslexic) pupils;*
- *to assess the use for mastering technical key subject words and preparation of revision notes.*

The overall aims of the pilot evaluation study were reflected in the project. However, the specific focus of the project was to investigate the effectiveness of portable computers with students with Specific Learning Difficulties. Issues relating to the suitability of such machines to particular dyslexic learning profiles; the use of IT as a means of supporting writing skills for students with a history of severe literacy difficulties; the types of activities which portable computers support most effectively for dyslexic students were to be explored throughout the project.

However, it was also intended to assess whether the use of the machines made an impact upon the level of independence in learning for pupils and students with severe literacy difficulties, and to assess the practicalities of using portable machines, as opposed to desk top facilities, for those involved in the project.

Management of the Project

It was intended that the project should run from June 1993 to April 1994. However, final acceptance of the bids did not take place until the end of May and the first conference, briefing the managers of the 118 projects did not take place until the end of June 1993. It was decided that for the purposes of the evaluation study, which was to be carried out by NFER and NCET, April 1994 would remain the deadline. Nevertheless, it was agreed that to take the machines away from pupils and students who were still in the process of GCSE and 'A' level courses would not be supportive and thus, the students and pupils would be allowed the use of the machines until the end of the 1994 academic year.

Many of the projects got off to a late start because the hardware and software did not arrive until the end of the Summer term 1993 - not the best timing to set up the project, carry out product testing and provide a period of familiarisation with the machines for the pupils and students taking part.

The management of the project was unusual compared with the majority of the 118 projects in the study. Most projects were based in one institution, viz. a school, with a member of the school staff using the machines within a department with groups of pupils in their lessons. The management of this project was carried out in the Learning Differences Clinic in the School of Education, with five local schools and colleges acting as Associate institutions. The initial study had not anticipated such a complexity of administration, and the signing of Contracts was the first hurdle to be overcome. This was resolved by the drawing up of an Associate Contract by the University's legal department: all five institutions were bound to the main project by the Associate Contract.

In preliminary discussions with the institutions, it was agreed that a link person and support technician would be available to deal with any problems which arose while the machines were in use. The practicalities of having such

attractive machines on the premises had to be carefully investigated, taking into consideration split sites, open access buildings, location of technical backup and learning support staff, security and housing while not in use and availability to students. All the feeder schools and colleges were most accommodating and responded flexibly to this new resource within the institution.

An integral part of the project was to monitor the use of the machines at home. The parents of the participants were involved at the outset, and all agreed to take out extra insurance to cover problems which could arise when transporting the machines between home and school/college. Full parental support and encouragement has been maintained throughout the project.

In order to monitor progress and to provide specialist teaching support for the individuals concerned, each participant attended the Learning Differences Clinic on a weekly or fortnightly basis and was seen by the project manager for an hour of individual tuition.

Criteria for selection of pupils and students

All the participants had to have a history of Specific Learning Difficulties. Such terms as Specific Learning Difficulties and Dyslexia have caused controversy for many years and attempts at definitions have resulted in a plethora of 'confusing' terminology. There are many inter- and intra-professional differences concerning the conceptualization, aetiologies and identification procedures for children with reading and language difficulties. Hinshelwood, a Glasgow eye-surgeon, in 1895 in the Lancet used the term 'word blindness' in connection with visual memory in adult aphasics. This prompted a doctor to link this with the case of a 14 year old boy who could not read and who had grave difficulties with learning to spell. 'A case of congenital word blindness' still haunts the layman's terminology and affects awareness and understanding.

In 1968 the World Federation of Neurologists referred to dyslexia as

" a 'disorder' in children who, despite conventional classroom experience, fail to attain the language skills of reading, writing and spelling commensurate with their intellectual abilities."

The Under Secretary of State for Education added to the confusion at the fifth sitting of the Special Standing Committee on the 1981 Education Bill by saying:

" the baffling condition popularly known as dyslexia, a category which is difficult to pin down but which exists as a learning difficulty. Of that there is no doubt."

Current legislation provides us with a definition:

"..... children of at least average ability who experience such difficulties in one or more of reading, writing, spelling and mathematics and..... require special arrangements....."

Education Act, 1993

However, for the purposes of this project the definitions of the British Dyslexia Association and the Dyslexia Institute provide a sharper focus.

" A specific difficulty in learning, constitutional in origin, in one or more of reading, spelling and written language, which may be accompanied by difficulty in number work. It is particularly related to mastering and using written language (alphabetic, numerical and musical notation) although often affecting oral language to some degree."

British Dyslexia Association.

" organizing or learning deficiencies which restrict the student's competencies in information processing in motor skills and working memory, so causing limitations in some or all of the skills of speech, reading, spelling, writing, essay writing, numeracy and behaviour."

Dyslexia Institute.

Seven students were chosen to take part in the project:

- * a male and female participating in Key Stage 3;
- * a male and female participating in Key Stage 4;
- * two males and one female Post 16 students
 - one of whom was re-taking his first year B.TEC National in Science;
 - two of whom were upper 6th 'A' level students.

All seven participants were chosen because of their long term, severe Specific Learning Difficulties. Five of them are statemented under the provision of the 1993 Education Act: one was identified at the age of six, while the other four have been known to the LEA for a period of between four and six years. Five of the seven participants have regularly attended the Learning Differences Clinic in the School of Education thus a detailed history of their learning difficulties was available. The final two participants, though not statemented for their Special Educational Needs, have had a history of difficulty which has been addressed by the local schools but which was still cause for concern with both teachers and parents.

Preparation and Set-up

After the initial meetings with parents and subject teachers in the different establishments, all the machines had to be set up for use, software installed and the products tested before they could be issued to the participants. The 'A' level students were anxious to use their machines at the beginning of the academic year and were given training sessions in the Windows environment during the Summer holiday. This period enabled them to familiarise themselves with the basic file management systems and the use of the word processing package within Microsoft Works. It also provided me with the opportunity to become familiar with the Advance program for the Acorn A4 which I had not seen until the start of the project.

Technical problems were minimal with the PC machines: but a major difficulty occurred with one of the Acorn machines which resulted, after frustrating telephone encounters with the back-up technical support division of Acorn, in the machine being recalled for 'further tests'. A replacement machine was provided but was not accompanied with the Advance software. As time was advancing, contingency plans were made so that the F.E. student could have the machine in order that his start time was not further delayed.

Use of the machines, including frequency and type, was negotiated individually with the participants. At all stages in their learning process, the students are encouraged to adopt a metacognitive approach to their learning. Metacognition has been described in a variety of ways: 'an individual's knowledge about various aspects of thinking' (Moore, 1982); 'the abilities of individuals to adjust their cognitive activity in order to promote more effective comprehension' (Gavelek & Raphael, 1985). The students who attend the Learning Differences Clinic are made aware of the importance of 'learning about themselves as learners' as part of a vital link in their progression. They have learnt to gradually take control of their learning by monitoring techniques which they are able to turn into strategies in any learning situation.

Each student had to take a critical look at themselves and the uses to which the portable computer could be put in order to help them decide how to use their machine to the best advantage in their circumstances. They were asked to consider:-

- their strengths and weaknesses in the learning situation;
- to assess priority of needs in their present circumstances;
- rooming within the timetable;
- subject suitability;
- peer grouping and personality considerations;.

Thus, from the outset the students were given a sense of control of operation, based on 'educated' decisions about their abilities and needs.

No student took the machine into lessons unless they felt in control of the technology. This was an important factor for students who, in the past, have experienced literacy difficulties. Many had built up complex, work avoidance strategies so that they did not appear to fail in front of their peers. It was, therefore, crucial for their self-esteem and for the future success of the project that they were confident to use the machine in, what was for them, stressful 'writing' situations in front of other students.

Use of the portable computers

Two main areas are considered: the frequency of use and the diversity of use. In a project such as this, with the complexity of resource management in a number of different establishments, great onus was placed upon the students to play an active part in the monitoring and evaluation of use.

Frequency of use was determined by both internal and external factors:

- Matching self confidence and proficiency with the purpose;

- Accessibility of power supply in various classrooms;

- Weight of the machines;

- Teaching style delivery;

- Group bonding - group work arrangements

- Organisation - transportation of mains equipment

- charging of batteries;

- Type of 'expected product'.

The students needed to have a certain degree of competence in the use of Word Processing facilities if the machines were to be used independently and frequently in the classroom in order to support their learning difficulties rather than adding to them. It is particularly essential for students who have a history of learning failure in literacy and who may also experience secondary emotional difficulties associated with their learning problems to have a period when they can use the machine in the security of their home surroundings. All the students were encouraged to use the machine at home for their homework tasks in the first instance while they became familiar with the machine, increased their key boarding skills and built up a degree of self confidence in use. This could be compared with the early stages of language acquisition when the learner needs to be immersed in the sounds of the language without the pressure of having to instigate language. A "silent period" (Dulay, Burt & Krashen, 1982) enables the learner to concentrate upon comprehension. A model for the growth of competence in writing development by Doughty, Pearce & Thornton (1972) suggests four stages, the second of which is familiarisation. This familiarisation period is more crucial to those experiencing learning difficulties. They need time to develop technology skills as a means to literacy acquisition so that they are not further delayed in the production of written work which is, for them, one of the main foci of their disability.

Frequency of use was, at times, limited by the machines. All the students commented upon the excessive weight of the machines and this factor determined whether the student took the portable into school/college on a

particular day. The younger students' decisions were made using external factors as the criteria and hinged upon other school equipment needed for the day's timetable (such as carrying P.E. kit and Home Economics equipment as well as the portable computer); the older students' decisions were made from the inside — out. They tended to weigh up priority of need and tended to look at the written outcome of work and asked whether the machine supported their needs more effectively. The students also had to take into consideration the battery life and accessibility of mains power supplies in different classrooms. The latter varied greatly, depending upon the age of the buildings and the planning given to accommodation of IT. All of this put pressure on the already stretched organisational powers of the dyslexic students. They had to ensure that they got into a routine of charging and deep-cycling the battery packs, daily forward planning to work out anticipated time of use in various subject lessons and remembering to take the mains power supply if they anticipated heavy use throughout the day. Thus, at the beginning of the project, the frequency of use may have been determined by their inability to anticipate how long they would need the machine; their inability to plan ahead the charging of the machine the evening before and forgetting to take the mains power supply with them - or choosing not to take it because of the extra weight involved in carrying it two to four miles!

Frequency of use was sometimes determined by personality and the group dynamics. The Key Stage 4 and post 16 students did not always feel confident enough to move around the room in order to gain greater accessibility to power supply points because they did not want to upset the strong group bonding which had already been established or they were not used to working with other groups. The secondary emotional factors of learning disabilities and self perceptions of ability within groupings affected choice and frequency of use at the beginning of the project. The students stated that an additional limitation to frequency of use was on-going group work. Six of the seven students, however, noted that many of these factors diminished in importance as their competence increased and the novelty factor of machine use decreased. Many of these limitations of use linked with group dynamics were reduced for the Year 7 pupil attending the local Middle School: this can be explained by the small size of the school and the less complicated time-table arrangements compared with those for secondary and post 16 establishments. The Year 7 pupil had to make fewer choices of change of group working; although he had to work with different pupils, it was always within a more confined setting than that with which the older students had to cope.

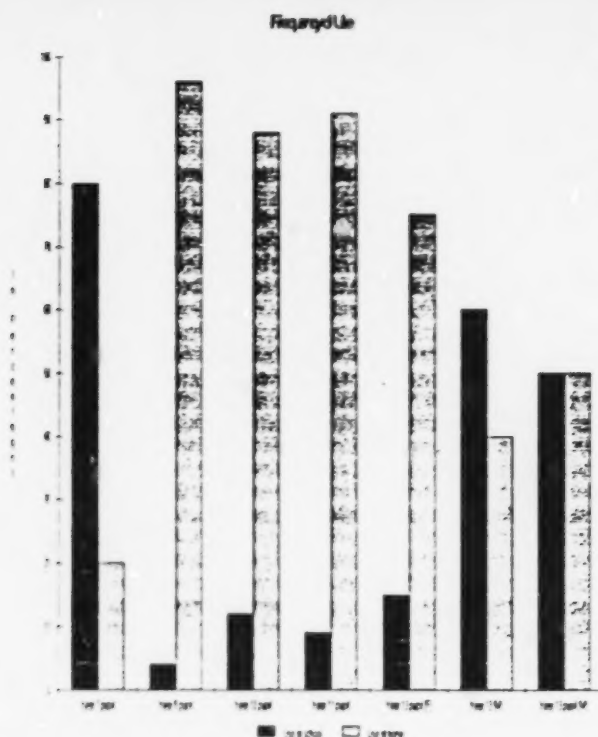
All the students kept a log of use throughout the project. This showed that portable machines in the classroom have implications for teaching as well as implications for impact on students' learning. Frequency of use was sometimes determined by teaching style delivery, type of work and type of written end product.

The post 16 students used the machines more frequently in the classroom situation because of lesson delivery which involved more note-taking from

overhead projector or board than that encountered by the Key Stages 3 and 4 students. The post 16 students had theory lessons which required them to produce notes for revision purposes at a later stage and provided them with information which would be expected to be used as part of a written assignment.

One year 11 participant used her machine for the production of coursework for Food Studies, English Literature and Language, Geography and CDT. Consequently, frequency of use in the classroom was confined to the continuation of coursework, when the teacher allowed time for this activity. The Year 10 participant's use was often confined to the home. His circumstances were different in that he attends a Unit for Emotionally Disturbed pupils and, in order to reintroduce the pupils to the educational system, there is not the same pressure of work placed upon them as that experienced by other Year 10 pupils in mainstream schooling. Much of the daily work in the classroom is worksheet-orientated, and consists of small units of work because of the transient nature of some of the clientele at the Unit and in order to accommodate their emotional and educational difficulties. This type of delivery does not easily utilize the potential of the machine. However, this pupil used his machine frequently at home to develop his imaginative talents, working on plays and newspaper articles for the Unit.

The Year 8 pupil elected to use her machine at home for completing homework activities. The Year 7 pupil used his machine most frequently in school: the type of homework activity set and the weight of the machine were the factors which determined his decisions. As a primary school pupil he was involved in 'project' activities of exploration as part of his National Curriculum work. The teacher gave a lead session at the beginning of the week, setting up the work and explaining the methods of research which the pupils could undertake. All instruction and work sheets were given to the pupils to work on during the week at their own pace. They were allowed to set their own priorities and work independently for some of the time. The Year 7 participant decided to use his machine for 'project' work in class because much of the work he produced was of an extended type, and he felt it was more suited to computer production than the short sentence responses required by the worksheets. He used his machine infrequently at home because the nature of the homework was often short answers on worksheets. His older brother had a desk-top machine at home which he used for the completion of his GCSE coursework. The Year 7 pupil could use this facility if he wished and transfer data to school work.



Diversity of Use

The nature of the project was such that the participants initiated and directed the use of their machines: there were no instances of teacher-directed use. Diversity of use was, to some extent, dependent upon age and the type of written work expected at different stages in the educational setting. Some types of activity were used by all the students to support their disabilities while others were stage dependent.

Diversity of Use

Category of Use	All Ages	KS3	KS4	Post 16
Drafting	x			
Note taking (in lessons)				x
Note Making		x	x	
Extended Written Work	x			
Multi-tasking activities		x	x	
Newspaper Articles		x		
Graphing		x	x	
Merging text from different programs				x
Merging graphs from different programs				x

Caregory of Use	All Ages	KS3	KS4	Post 16
Drawing	X			
Display work	X			
Report writing				X

Table 1.

Multi-tasking activities refer to activities where the student is expected to listen to data/information, process and hold information in short term memory, record information in some type of written format after processing and carry out some type of practical activity. Such an example could be carrying out experiments in a Science lesson, recording the results and completing an experiment report; or watching a video film and taking notes for further use for written assignment work.

As Table One demonstrates, diversity of use depends upon the Key Stage. As the dyslexic students advance through the educational system, the demands placed upon their Literacy abilities increase. The complexity of the work and the expectations and demands increase proportionally so that the portable computer was of greater use to the older students in an academic setting. This may also be explained by the change in delivery which occurs as the students progress through the system.

Impact on Students' Learning.

The main difficulties experienced by the dyslexic students in connection with their school/college were:-

- * spelling
 - both in terms of retrieval of letter patterns in sequential order and recognition of sound to symbol relationships;
- * poor presentation of written work
 - in terms of inability to remember the shapes and direction of certain letters;
- * processing of complex language structures on output both orally and in written output;
- * all associated written work;
 - structuring sentences, paragraphs and extended pieces of work;
- * time management of written work
 - inability to estimate length and time of work
 - duration disproportionate to task because of associated difficulties;
- * proof reading of completed work
 - poor visual perception and visual discrimination
 - poor auditory perception and discrimination;
- * organisational difficulties associated with school/college timetabling;

- * hesitant reading skills
 - text books and worksheets
 - inability to read their own handwritten work;
- * sequential processing and thought structures;
- * multi-tasking
 - having to listen, process language, visualise the output and translate on to paper, retrieving shapes and patterns.

All the students experienced the above difficulties to some degree of severity. Despite this, they were all motivated to succeed but showed considerable signs of anxiety when asked to perform any literacy-related tasks. By the end of the project all the students' levels of motivation, except the Year 8 female, increased with the use of the machines. At one stage the Year 10 pupil was using his machine so much in the evenings that his mother put a time limit on use so that she could see him occasionally.

For the older students the volume of written work has increased, and the ability to cope with taking notes and information in lessons has improved. Inability to visualise the 'product', i.e. the layout of notes on paper from oral information, coupled with poor organisational skills, and the pressures of keeping up with the spoken word whilst processing it into another medium has a knock-on effect for learning. Using the facilities of the word processor, viz. 'cut and paste', 'insert', 'delete' and 'copy', has enabled the dyslexic students to not only keep up with note taking in lessons but has enabled them to concentrate upon the conceptual aspects of the information instead of focusing on the mechanics of getting symbols onto paper. In addition they have ended up with a set of notes which can be of use to them for other learning purposes. As one student commented: "At last I have my own notes which I can read because they make sense and are clear." Because the students are going through this 'normal' learning process while making notes, they are able to speed up the time it takes to structure and process information into assignments..

Attitudes to work have changed since using the portable computers. What was previously a laborious task, to be got out of the way as quickly as possible, has now changed. All the students use the drafting process correctly and with ease. In the past, drafting meant writing out work, word for word, so that it looked neater and the teacher could, hopefully, read it. This was a tiring process and one which was not always fruitful for the dyslexic student - the second 'draft' could contain more spelling and grammatical errors than the first, indecipherable copy. Revisiting work to consider the quality of structure and use of vocabulary was a luxury the students could not afford. However, with word processing facilities many of these mechanical aspects of drafting have been achieved quickly allowing the students time and energy to consider the quality of their final copy.

Learning styles have altered throughout the project. All the students have been taught a system to help them to proof read their work. Whilst they are confident to check spellings on screen, the rest of the proof reading system is done from a hard copy which is double spaced for this purpose to help overcome some of their visual perception difficulties. All but the two youngest participants proof read work before it was handed in to be corrected, and the primary school pupil is beginning to build proof reading into his scheme of work. This has been supported by the Special Needs Assistant (SNA) who has helped him to organise his lesson time in such a way that he allows five minutes before the end of each lesson to proof read the lesson's work. Although he still needs these reminders to build routine into his learning, he fully supports the process, realising that it is quicker to proof read small sections on a regular basis than to save unchecked work and complete a final proof read prior to printing. He attempted the latter once and after thirty minutes at home checking through the numerous mistakes he had noticed, he had to ask his mother to help out so that he could complete the task in time to hand in the work the next day.

Key Stage 3 pupils are encouraged to write out their first draft on paper. They then transfer this to the computer for further drafting. When staff were questioned about the efficacy of this, their main concerns revolved around the Orders for handwriting in the National Curriculum and a desire to ensure that the pupils do not lose their ability to use cursive handwriting and to ensure that this skill is practised. This was not something which the teachers of the older students considered, and they preferred the students to work straight onto screen and produce all written work on the computer. The preoccupation with handwriting as a skill is disproportionate to the overall value given to it within the National Curriculum where this skill accounts for only one sixth of AT3 and only one twelfth of the overall ATs for English. However, it is also a reflection of the historical perspective of the place given to handwriting in the education of young children. Teachers of older students placed more emphasis on the quality product rather than the process itself and the mechanics underpinning this. It is interesting to observe the changing shift of significance as pupils progress through the system. This may be accounted for by many factors:

- the availability of computer facilities in 6th Form Colleges compared with that in primary schools;
- the levels of personal expertise and confidence of IT use by members of staff - this may be closely linked to the previous factor;
- the changing educational needs of pupils at various stages - the need to pass on the skill of cursive writing in the early stages;
- the more urgent need to respond to the IT demands of Industry, Commerce and employment markets, the closer the student is to that market.

Attitudes to Spelling

There has been a noticeable change in all the students' attitudes to spelling and self-image with regard to spelling. There has been an improvement in their ability to remember the spelling of frequently used words. Most of the students stated that the computer has helped them because they could remember the feel and movement of left and right hands on the keyboard. They did not have to remember the sequence of the letters and therefore did not experience so many reversals or missing syllables. This kinaesthetic factor has deflected their difficulty with symbols. Using the spelling checker regularly has resulted in a greater awareness of their own types of spelling errors, and those who adopted the 'global failure' view of their spelling ability have noticed that their errors often occur at the same place in words, for example, difficulties with middle or final sections. This has had an effect upon how they perceive themselves as spellers. This increased confidence has resulted in a willingness to use their oral vocabulary as opposed to restricting themselves to simple words which they felt more able to attempt.

Students' Attainment Levels in curriculum areas

Although it has not been possible to carry out detailed quantitative studies in the time available for this pilot evaluation, both staff and students have commented upon the rise in the standards of work as a result of using the portable computers.

Communication levels have increased because of improved sentence structure, use of punctuation and decipherable spelling. The savings in time afforded by the use of the word processor have enabled the participants to pay more attention to higher order skills and refinements of text. No longer have they had to limit their vocabulary use according to their spelling ability. The Further Education student, who is resitting the first year of his course, has been able to make direct comparisons of the grades of his written assignments. In all cases these have improved and in most cases this improvement has resulted in an increase of two and sometimes three grades.

Students' IT Skills

Keyboarding skills have made the most noticeable progress. All, except the Year 8 female, have increased their speed and use both hands on the keyboard. Their self confidence has developed and they are prepared to use the keyboard, not only in front of peers and teachers, but also when visitors observed their use in the classroom. This is a significant move forward for students with a history of literacy difficulties who have spent much of their time developing avoidance techniques for any work associated with writing.

Six of the participants can use the basic word processing facilities of delete, cut and paste, centring, underlining, font changing, saving and printing. The older students have made use of tab settings, merged text from various

documents and imported data from other 'Works' programs. All the students have used the basic facilities of the desk top publishing package 'Publisher'. Depending upon the type of work set, some have learnt to make use of the 'page wizard' facilities to provide appropriate shells for the presentation of their work.

At all stages in the learning process the students were given instruction in the various facilities, according to individual need and to reflect their learning curve. This worked well because it did not overburden weak sequential memory skills and was seen as relevant to their immediate situation. Thus, their IT skills developed in conjunction with their subject skills. IT teaching was not a 'bolt-on' process but rather an enhancement of the National Curriculum. It was seen by the students as a natural adjunct to their subject curriculum work, and a tool which enabled them to survive and at last compete with their peers on a more equal footing.

Independent Learning Styles

All the participants have been encouraged from the outset to take a metacognitive approach to their learning so that they can become managers of their own learning environment, making decisions from a position of knowledge which are appropriate to their circumstances. With only one hour session of tuition per week/fortnight the students are plunged into situations where they have to learn to cope. However, the availability of the portable computer has provided more opportunities for independence. It has given the students the confidence to tackle written work with the realisation that mistakes could be rectified quickly. A further degree of independence has been achieved by the use of the spelling checker and thesaurus. Thus, the students have been in command of the progress, and this has not been hindered by the availability of an adult, either in the classroom or at home.

It is the students who have decided when it would be most appropriate to use the portable computer: decisions which have been possible because of a knowledge of their strengths and weaknesses and their evaluation of the process and product, enabling them to match individual need and subject demands. Such independence has been a liberating experience for six of the participants.

Organisational Factors

The nature of the project was such that only simple infrastructures were required to be initiated in the various institutions. The students took total responsibility for their machines (including extra home insurance to cover transportation to and from school). A simple storage system was organised so that the student could deposit the machine in a safe and supervised area during P.E. lessons and on the rare occasions when the machine was not intended to be used. All the participating institutions had an infrastructure in

place which needed only minor adjustments to accommodate individual needs. In the majority of institutions, the Learning Support Area was used.

Battery charging was the responsibility of the individuals, all of whom had instruction on deep cycling routines and the importance of temperature when recharging. All students adhered to the system and machine failure was the most effective monitoring system for this! Access to printers did not prove difficult because additional use was limited to one student per institution.

The students were encouraged to back up all their data on floppy disk. The organisation of the weekly tuition supported this good practice because often the students brought only their floppy disk to the session. The older students used complex filing systems on hard disk which, to some extent, reflected their circumstances. The Windows setup needs to be child proof from the outset. As a non-IT specialist, I would have welcomed information about how to customise the package before the machines were distributed; thus, reducing niggling problems with 'fiddlers' who had a little knowledge!

The dedication of the machines to individuals cut down on many administrative and technical problems. All the participants took great care with their machines and therefore damage or even opportunities for damage were limited. As noted in earlier reports, the back-up by distributors was patchy. I only contacted them when the problem was so serious that it required machine recall. Services for the Acorn A4 were slow. These machines were given to students with disabilities who came to rely upon the machines to help them survive. For the machines to be removed for repair for long periods when a level of dependence has been encouraged must be questioned on moral as well as academic grounds. If this is not tackled at this stage with the suppliers, the market will not develop.

The Use of Portable Computers and Dyslexic Profiles

Dyslexic students place great faith in computers and believe they will be the panacea for all their learning failures. With such high expectations, it is little wonder that some students are bitterly disappointed with computers. Not having to worry about the spelling of words, being able to control words which have always seemed to tumble on to paper without structure, being able to hand in neat, well presented work are the attractions which draw the dyslexic students to computers. However, they think the machine will do all the hard work for them and will detect their errors in spelling and grammar and quickly transform their writing. Thus, they are shocked when they realise that they still have to work at their literacy and writing and that they do not have a tame automaton to tidy up their mess for them.

It is vital, therefore, that students who have a history of learning failure are properly prepared before they are introduced to and provided with a computer. A knowledge of the limitations of the computer for dyslexic difficulties is essential so that they can use the computer more effectively, learning

techniques to support both their limitations and those of the computer: knowledge of their strengths and weaknesses and how the computer can assist are prerequisites to success. In other words they must have realistic expectations and an awareness of need. Their first experiences with the computer must be successful not only when considering future progress but if their fragile emotional state is not to be shattered. Teachers need to take into consideration the elements of the writing process, the individual's learning profile and a system of staged, progressive support in order to devise an effective programme of work.

A look at the components of writing demonstrates potential areas of difficulty for dyslexic writers, and offers possibilities for the use of computers.

COMPONENTS OF WRITING

COMPOSITION

Ideas
Vocabulary
Grammar

TRANSCRIPTION

Handwriting
Spelling
Punctuation

Paragraphing

Lack of automatic skills in transcription inhibits the flow of ideas and the ability to express what the author wants to communicate. It is often the transcription skills which are weak links in the chain for the dyslexic student. Language processing and sequencing difficulties also affect grammatical structure and paragraphing. Acute handwriting difficulties frequently occur because of severe visual memory, visual sequencing, visual perception and confused directionality. The result is that the student has to spend more time working out the shape of a letter and which way round it goes. This has to be worked out at the same time as the student is trying to translate sound into symbol and to recall the sequence of the pattern of letters. Is it little wonder that the student forgets or cannot concentrate upon the flow of ideas when the brain is overloaded with the mechanics of handwriting?

The laborious elements of transcription for the dyslexic can be carried out to some extent by the computer, allowing the writer time and brain space to concentrate upon ideas and the expression of those ideas.

As with all processes the student requires support at different stages in the continuum as he moves from a novice to an independent writer. In order to develop the composition skills while the student is increasing his competence in transcription, it may be necessary for the teacher to act as the mechanic, providing the keyboarding speed which keeps pace with the pace and flow of ideas from the dyslexic student. Gradually the process can be handed over to the student as his keyboarding skills improve.

The success or otherwise of the portable computer for the dyslexic student rests upon a number of factors:

- the severity of the dyslexic difficulties and to what extent these difficulties form a barrier to survival in the academic setting;
- the effect of the secondary emotional factors on learning;
- the speed and proficiency of handwriting;
- the school's/college's IT ethos;
- the level of computer use in the school/college;
- individual motivational factors;
- the type of spelling errors generated by the individual;
- stage in the educational continuum.

Dyslexic Profiles

	Phonetic Speller	Visual Difficulties	Auditory Difficulties	Processing Difficulties	Handwriting Skills - Poor
Student 1	X	X	X	--	X
Student 2	X	X			
Student 3		X	X		X
Student 4	X	X	X	X	X
Student 5	X	X	X	X	
Student 6			X	X	
Student 7	X		X	X	X

Table 2

Factors which are more likely to ensure successful use of the portable computer are:-

- severity of difficulty which results in greater need for the support offered by the machine;
- poor handwriting skills;
- slow speed of handwriting;
- high motivation;
- phonetic spelling patterns;
- a 'mastery-orientated' pattern of behaviour, described by Dweck & Leggett as one which accepts challenges and which allows the student to interact effectively with others.

The above factors are more important than the level of computer use and the IT ethos in the school/college. However, there can be a crucial relationship if the secondary emotional factors are predominant.

For some students the portable computers were not a luxury but a means of survival because of the severity of difficulties, coupled with their very poor speed of handwriting. However, if the student has developed a reasonable level of proficiency in handwriting and can keep up with the many aspects of writing, albeit at a superficial level, initially the use of the portable computer appears to slow down the writing process and can act as a deterrent. This proved to be the case with the Year 8 participant, although personality factors and the level of computer use in the school also mitigated against success.

The Year 8 student had developed a neat, cursive style of which she was proud. Her speed of handwriting was adequate to meet her immediate needs in school. She was more concerned with the completion of work rather than the quality of work, reflecting her ability. A history of difficulties, together with poor self worth, resulted in self-effacing tactics in the classroom. She was constantly at pains to cover up her difficulties and did not wish to stand out in any way in front of her peers. The level of computer use in the school generally was low. Thus, if she was to use her machine in school, she would become the centre of attraction and she felt that the spotlight would be placed on her learning difficulties.

Initially, her keyboarding skills were slow, and this meant that written work took longer on the computer. For a student anxious to get written work out of the way as quickly as possible, this did not bode well. Her use was confined, by self election, to home where there were fewer opportunities for success and for sustained practice.

She has developed other techniques for coping with her weak spelling and, until she gains more self confidence in her academic ability, the portable computer is not the best solution to her difficulties.

If computers are to be used as an aid for learning for dyslexic students, it is important that teachers bear in mind the way computers work and the typical learning profile of a dyslexic student. Computers employ a logical way of working which could present difficulties for those dyslexic students with sequencing difficulties. The sequence of operations is often crucial to success and even simple operations present hurdles for the dyslexic learner. While the students were learning operations such as saving work, or printing work, to aid sequential memory difficulties, each stage of the operation was put onto a card. For those with weak reading skills, numbered, pictorial instructions were drawn on the cards.

For dyslexic students one of the great attractions of the computer is the spelling checker. Most programs use a phonetically based spelling checker, and are therefore able to interpret more easily the attempts of dyslexic students who rely heavily on Phonics as a means of working out the spelling

of unknown words. However, if dyslexic students have poor visual and auditory perception, their attempts at spelling are often unrecognisable and difficult for the computer to interpret. The students were disappointed when they saw 'no suggestions' appear on screen. They soon realised that if this facility was to work for them they had to put some simple linguistic rules into operation and use these as an elimination check list when the computer could not suggest any alternatives. They had to check that:-

- there was a vowel in each syllable;
- the first two letters were as accurate as they could make them;
- they had not missed out a syllable;
- the ending was fairly accurate;
- they checked for their known errors.

By using these techniques, even those with severe spelling difficulties can use the spelling checker more effectively and productively.

Two of the participants have complained of headaches after a couple of hours of use. One of the students has had an anti-glare coating put onto her lenses and it will be interesting to see if this has any effect.

Portables in Action

The success and progress of the students has not entirely been the result of the portability of the machines. Much of the work carried out by the students could have been done on a desk-top computer. However, for note taking and multi-tasking activities the portable computer has been essential.

For the dyslexic student the portability of the machine has opened up new frontiers. The flexibility and the independence which the machines have given has resulted in a greater willingness to tackle written work. NC levels of attainment in many subjects and levels of self esteem have been enhanced. Perhaps the long term gain would result in the student going on to higher levels of education: for example, the ability to cope with Higher Education rather than a cut-off at 6th form level.

Implications for further use

1. Teaching Styles

Teachers need to give more consideration to differentiation by outcome in the future and to build in an expectation of IT use. For example if a teacher is providing staged support for written notes for the dyslexic pupil or structured/guided written responses, then this must all be available on disk for the pupil to use.

Often worksheets are produced which require the pupil

- to insert words/short phrases in a body of text;
- to write short answers to questions after handling text;

- to label diagrams.

As well as providing hard copy, such data should be available on disk for use by pupils so that they can make greater and more appropriate use of portable computers.

Such a shift requires higher levels of awareness of use and has implications for professional development and ITT.

2. Handwriting in the National Curriculum

For some of the severe dyslexic students who fall in the 2% category, decisions need to be made about the efficacy of making them struggle with the mechanics of handwriting. Whilst not in favour of abandoning handwriting, for the most disabled children it may be necessary to teach keyboarding skills at an early age to open up the facilities which the word processor will give to support their learning disability. This has implications for assessment within the National Curriculum and funding implications for schools and the DFE. Although recognition of the development of IT with dyslexic students has been documented, the shift in teachers' IT awareness will take time to become more widespread.

"12.10 "Pupils with specific learning difficulties (dyslexia) should, given appropriate help, achieve as well as pupils without special educational needs.....they may benefit particularly from using word-processors, including spelling checkers."

English for ages 5/16, DFE, June 1989

AT4 Spelling

"At each level of attainment the use of technological aids by pupils who depend on them to produce their written work is acceptable."

'Curriculum for All', National Curriculum Council, September 1989

3. 'Written' assessment for examinations

GCSE, GNVQ, 'A' Level

The expected response for the above is handwritten scripts. Any variation from this requires application for Special Considerations. Having dealt with the examination boards for many years, I know how difficult it is to obtain the use of the word processor as a concession for candidates. This is only given with considerable backup evidence demonstrating that the student would be disadvantaged if not allowed the concession. The boards will only accept an up-to-date Educational Psychologist's report as supportive evidence. If students are unlucky enough to fall in the 18% of SEN then the process becomes costly and difficult. If, with more and more computer facilities being made available in schools and colleges, the dyslexic students become accustomed to using computers as a means, not only of overcoming and supporting their difficulties, but as their mode of working and producing written work, they will surely be disadvantaged in the examination system as the

regulations stand. There will need to be some radical thinking about these regulations in a world which accepts the use of word processors as a means of communication. Some of the dyslexic students on the project can write faster using their machine so therefore not only the quality but also the quantity of response would be drastically changed if they had to change to a mode of writing which they were not used to.

Conclusions

Schools in the year 2000?

- There still needs to be a much greater acceptance and awareness of the power of the computer in education by the teaching profession so that computers are taken as much for granted as the biro and pencil.
- I would hope that electronic communication between teacher and pupil and pupil and pupil is taken for granted and is possible with funding levels adjusted to accommodate.
- Multi-sensory language teaching has been hailed as the best approach for dyslexic people. With the strides being made in technology, with talking programs, with CD rom drives, this approach can be developed and really come into its own with the computer so that all learning, be it language or subjects within the National Curriculum, can be done through the best medium for the dyslexic learner.
- Greater and more inventive ways of differentiating the curriculum will be available for all students.

Microprocessors open up many opportunities and future technological developments are of great interest to ascertain whether qualitative and quantitative improvements can be made in learning for dyslexic students. Often the focus has been upon the improvements in presentation and spelling which the computer can facilitate: a study of the development of language processing and the role of the computer in this needs to be undertaken. The nature of the working of computers raises issues in the development of literacy for dyslexic students: for example, does multi-tasking on screen pose added difficulties to those with directional / sequencing problems; does sentence structure improve with the use of multi-sensory techniques through the medium of speech-generated programs; can scotopic sensitivity syndrome be alleviated with the use of different coloured screens?

This pilot evaluation highlights some of the potential problems which need to be considered when introducing portable computers to learning situations for dyslexic students. It also demonstrates that many factors need to be taken into consideration if the learning experience is to be increased for the dyslexic student. Matching the dyslexic learning profile with teaching outcomes is crucial to success.

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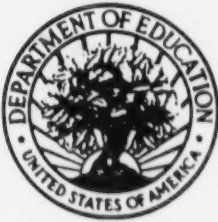
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Geraldine Price works in the Learning Differences Unit
at the University of Southampton



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